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CHILDHOOD LEUKEMIA AROUND FIVE NUCLEAR FACILITIES IN CANADA

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CHILDHOOD LEUKEMIA AROUND FIVE NUCLEAR FACILITIES IN CANADA

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INTRODUCTION

In November 1983, a Yorkshire Television (U.K) programme, entitled "Windscale-the Nuclear Laundry", suggested that there was an excess of childhood leukemia in the village of Seascale, near the Sellafield nuclear fuel reprocessing plant. Since then, a number of studies on the occurrence of childhood cancers around several nuclear facilities in the United Kingdom and elsewhere were published. The most significant study was that carried out by Gardner and his colleagues, which reported an increased number of leukemia deaths among children born to mothers resident in the vicinity of the Sellafield nuclear fuel reprocessing facility. A later study by the same investigator found an association between preconception external radiation exposure of the fathers and the subsequent development of leukemia among their children. In contrast to the observations made by Gardner and his colleagues, a number of other studies found no excess leukemia among children living in the vicinity of different types of nuclear facilities. Several other studies have found clusters of leukemia at places far removed from any nuclear facilities - and in countries with no nuclear plants at all, raising a further question of the possible impact of environmental pollutants, biological factors or social factors on the occurrence of childhood leukemia.

The types of radioactive substances and their relative amounts, in the effluents from reprocessing facilities in the U.K., are generally different from those in the effluents from Canadian nuclear facilities. Furthermore, Canada does not have any nuclear fuel reprocessing facilities. The amounts of radioactive substances in the airborne and liquid effluents of Canadian nuclear power plants, depending on the types of radioactive substances, are up to several orders of magnitude lower than the corresponding releases from the nuclear fuel reprocessing facility at the Sellafield site.

Nevertheless, in the face of these international developments, and of the concerns raised by the Canadian public, the Atomic Energy Control Board (AECB) of Canada decided to sponsor a study to test for the occurrence (if any) of similar clustering around its licensed nuclear facilities. Consequently, the AECB contracted the Ontario Cancer Treatment and Research Foundation to conduct an ecological study of the occurrence of leukemia among children living near major nuclear facilities in Ontario.

In this study, the incidence and mortality of leukemia among children, up to the age of 14 years, and born within a radius of about 25 km from five different types of nuclear facilities were compared with the provincial average. The five nuclear facilities considered in this study were: Nuclear Power Generating Station at Pickering (PNGS), Nuclear Power Generating Station and its associated facilities at the Bruce Peninsula (BNPD), Uranium Conversion Facility (UCF) at Port Hope, Uranium Mine and Mill Facilities (UMMF) in Elliot Lake and the Research and Development Facilities at Chalk River Laboratories (CRL) and the nearby Nuclear Power Demonstration (NPD) Facility at Rolphton.

METHODOLOGY

The leukemia data, both incidence and mortality, were obtained from the cancer records maintained at the Ontario Cancer Registry. The actual number of leukemia (observed number O) among children of 0-14 years of age, and born within 25 km radius from a given facility was determined for the period from the year of start-up of the facility to 1987*. The expected number of childhood leukemia (expected number E) for the same area, and for the same period, was calculated from the provincial average, matched for age and sex of the study population. The ratio of O/E, at 95% confidence interval, was used to determine the significance of the occurrence of any excess childhood leukemia around the five nuclear facilities.

RESULTS

The observed (O) and expected (E) number of childhood leukemias, and the ratio (O/E) for each nuclear facility, are given in Table 1. The ratio (O/E) is given separately for leukemia mortality and leukemia incidence, along with their upper and lower limits at the 95% confidence interval.

DISCUSSION

The ratio O/E was found to be less than unity for some facilities and greater than unity for other facilities (Table 1). In all cases, the lower and upper bounds of these ratios, at the 95% confidence interval, included unity, implying that the occurrence of the disease in the vicinity of the five nuclear facilities is not significantly different from the provincial average. The sample size is not large enough to distinguish between a chance occurrence and a true excess or deficit at such low levels as observed around the five nuclear facilities in Ontario. Furthermore, this study compared leukemia rates for various geographic regions, without studying the cause-effect relationship, and, therefore, a small excess or deficit (if any) of childhood leukemia could be attributed to several factors inherent in the specific environment, in and around each of the nuclear facilities.

An examination of the influence of several potential biases, such as urban-rural differences,under-registration of cases, missing life-births, migration out of the study area or the province, failure to trace birth certificates and exclusion of unconfirmed leukemia cases, indicated that the results of the study were not significantly affected by these factors. (In spite of the fact that there was no significant excess of childhood leukemia around these nuclear facilities, the AECB has funded another study, which is in progress, to examine any possible correlation between radiation doses received by the male workers at these Canadian nuclear facilities and the subsequent development of leukemia among their children.)

TABLE 1

Childhood Leukemia for Different Nuclear Facilities**

Facility	Observed(O)	Expected(E)	Ratio(O/E)	95% C.I
CRNL, Chalk River &	2	6.1	0.33	0.04-1.19
NPD, Rolphton	(2)	(6.3)	(0.32)	(0.04-1.14)
UCF, Port Hope	12	10.0	1.20	0.62-2.09
	(13)	(11.7)	(1.11)	(0.59-1.91)
UMMF, Elliot Lake	4	4.4	0.92	0.25-2.35
	(4)	(5.0)	(0.80)	(0.22-2.05)
PNGS, Pickering	33	24.6	1.34	0.92-1.89
	(72)	(62.8)	(1.15)	(0.90-1.44)
BNPD&Douglas Point,	3	1.1	2.78	0.56-8.13
Bruce Peninsula	(4)	(2.6)	(1.57)	(0.42-4.01)

** the data were obtained from INFO-0300-2, a report prepared for the Atomic Energy Control Board of Canada by Dr. A.Clarke et al., Ontario Cancer Treatment and Research Foundation.

*The quantities without brackets refer to leukemia mortality data for the period from the year of start-up of the facility to 1987. In Ontario, the leukemia mortality data is available only for the period 1950-1987

*The quantities within brackets refer to leukemia incidence data for the period from the year of start-up the facility or 1964, whichever is later, to 1986. In Ontario, the leukemia incidence data is available for the period 1964-1986.